

## **Item 9**

# **Status Update**

# **Russian River Watershed TMDL Development Efforts**

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**July 15, 2010**



# Topics

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- I. 303(d) List of Water Quality Limited Segments**
- II. Russian River Watershed Impairments**
- III. TMDL Development Projects**
  - 1. Reservoir Mercury TMDLs**
  - 2. Laguna de Santa Rosa TMDLs**
  - 3. Lower Russian Indicator Bacteria TMDLs**



# 2008/2010 303(d) List

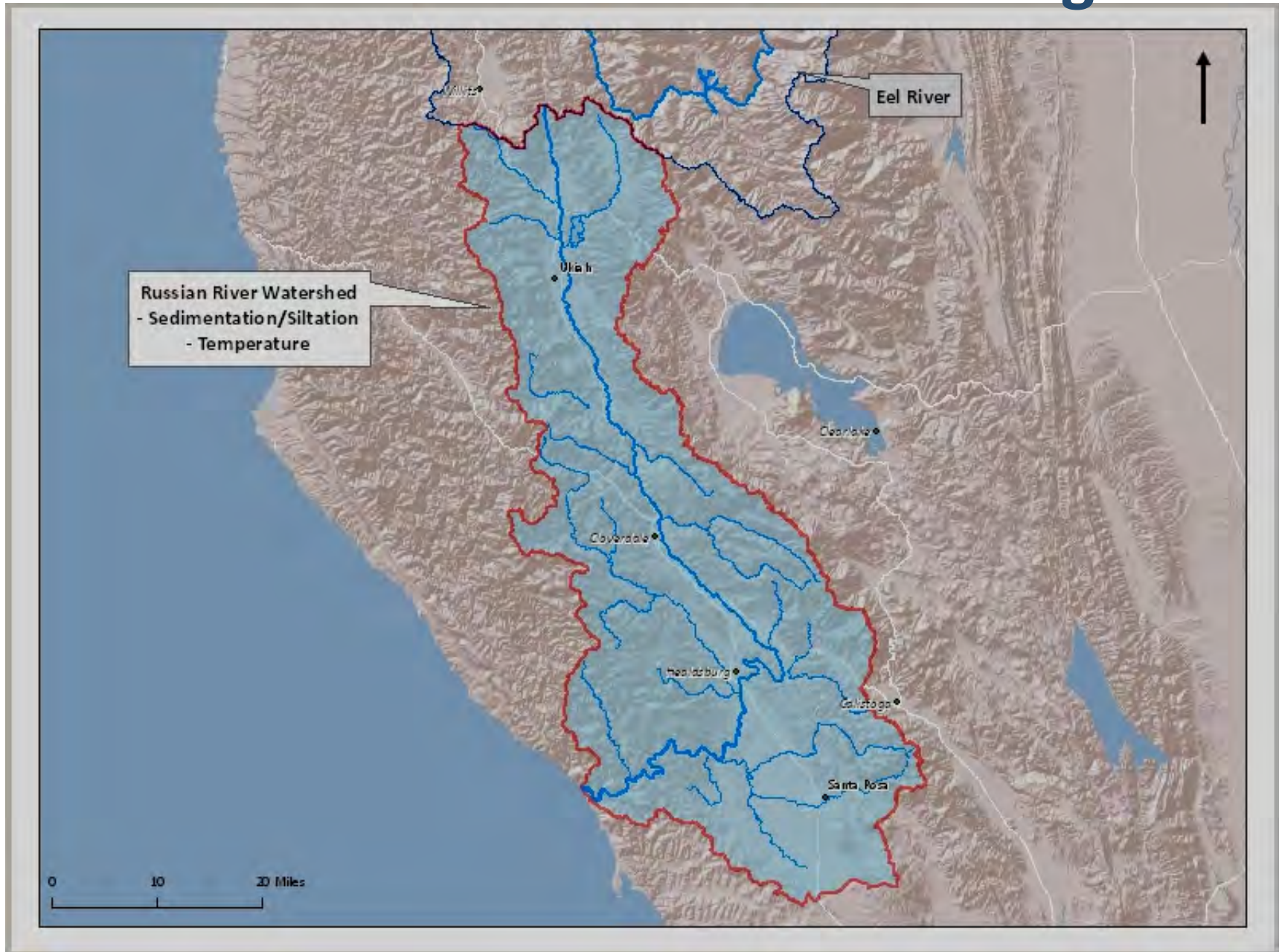
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- **June 3, 2009:**  
**Regional Water Board Adopted**
- **August 4, 2010:**  
**State Water Board Hearing**
- **USEPA expected to approve soon after State Board adoption**

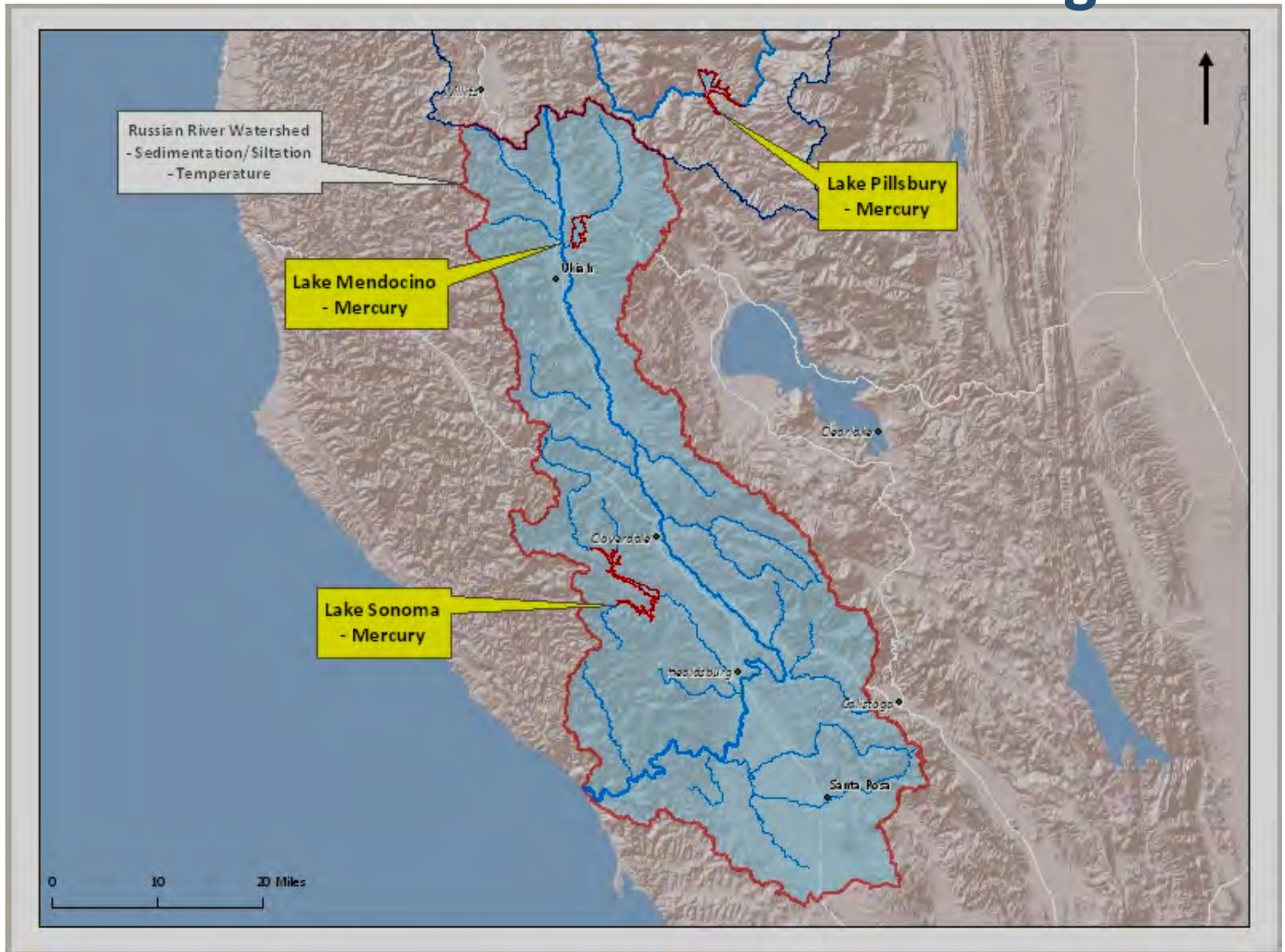
# Russian River Watershed Listings

Waterbody Name	Pollutant/Stressor
Russian River Hydrologic Unit	Sedimentation/Siltation Temperature
Laguna de Santa Rosa	Nitrogen and Phosphorus Dissolved Oxygen Mercury Indicator Bacteria
Santa Rosa Creek	Indicator Bacteria
Russian River – Healdsburg Memorial Beach	Indicator Bacteria
Unnamed Tributary to Russian (Stream 1) at Fitch Mtn	Indicator Bacteria
Russian River – Fife Creek to Dutch Bill Creek	Indicator Bacteria
Green Valley Creek Watershed	Indicator Bacteria Dissolved Oxygen
Lake Mendocino	Mercury
Lake Sonoma	Mercury
Lake Pillsbury	Mercury
Big Sulphur Creek Hydrologic Sub-Area	Specific Conductivity

# Russian River Watershed Listings



# Russian River Watershed Listings



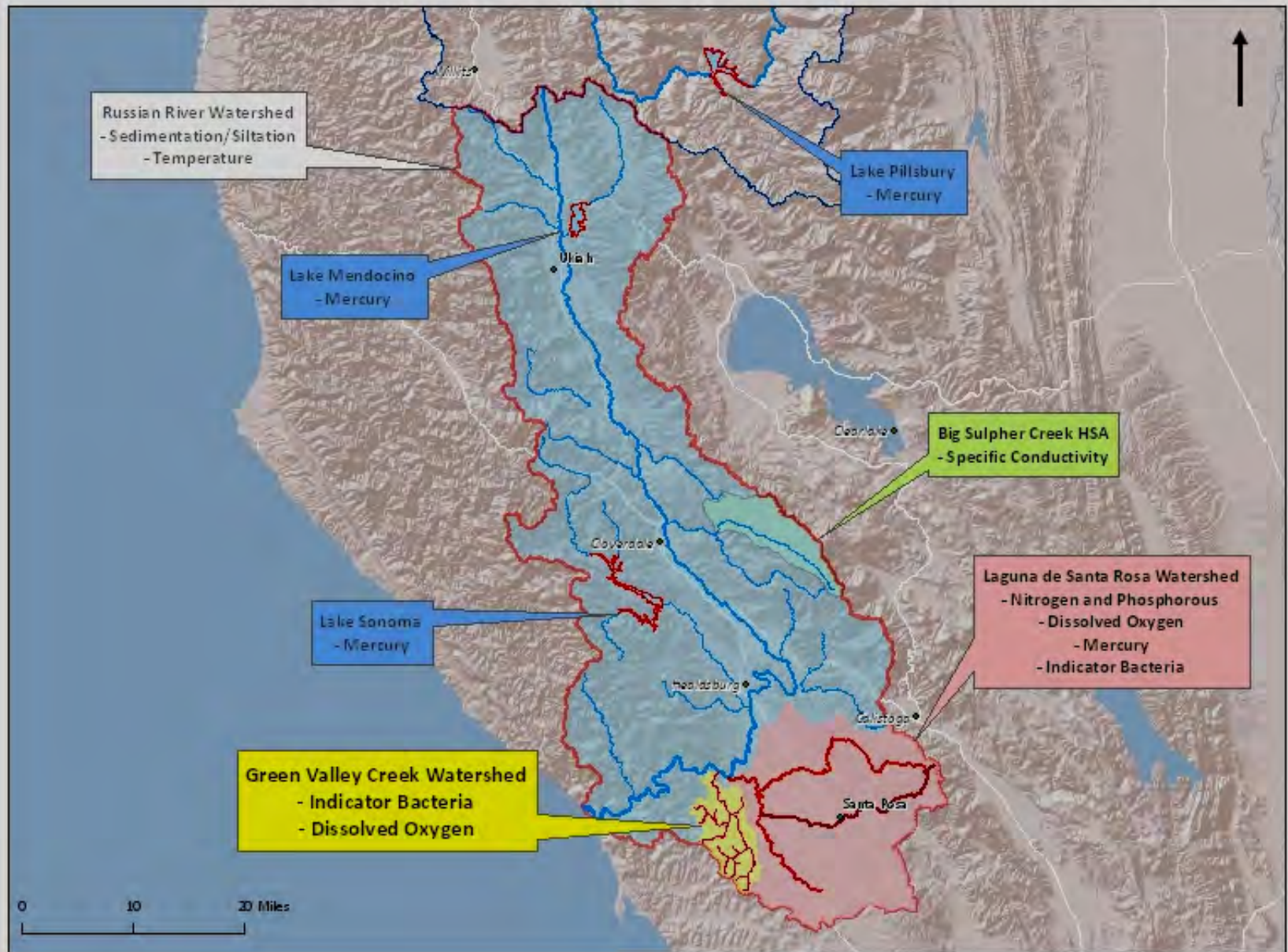
# Russian River Watershed Listings



# Russian River Watershed Listings



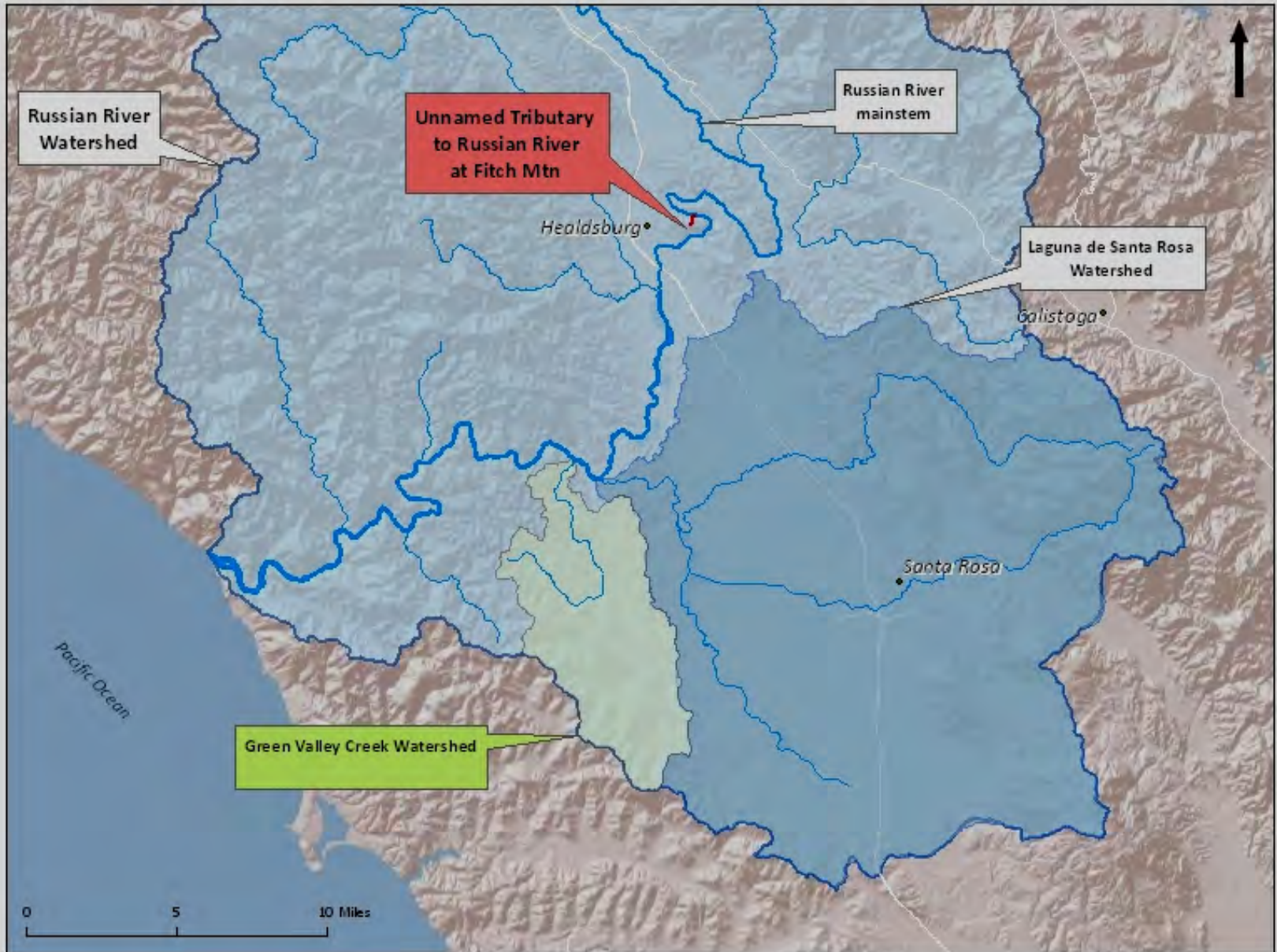
# Russian River Watershed Listings



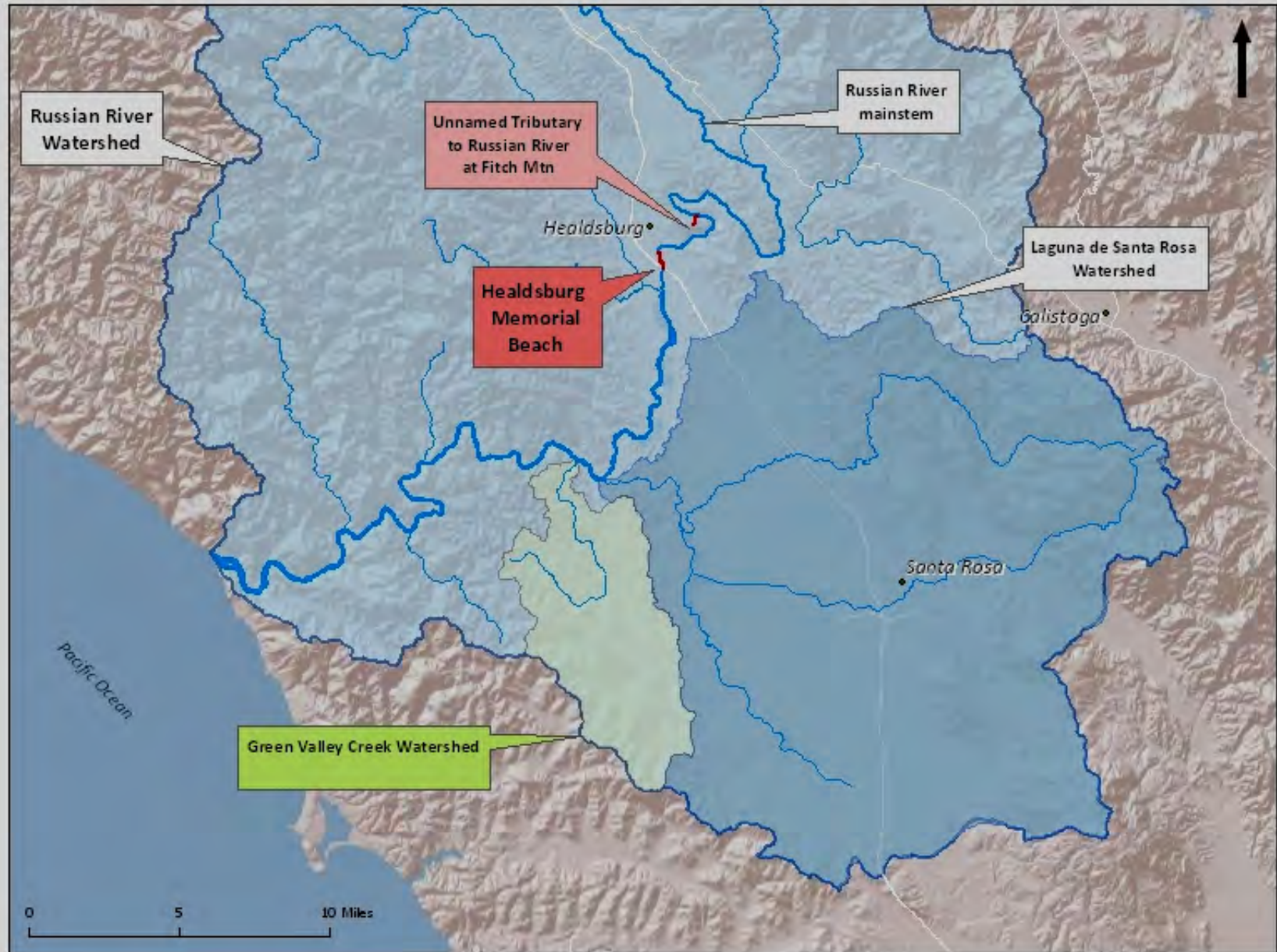
# Russian River Indicator Bacteria Listings



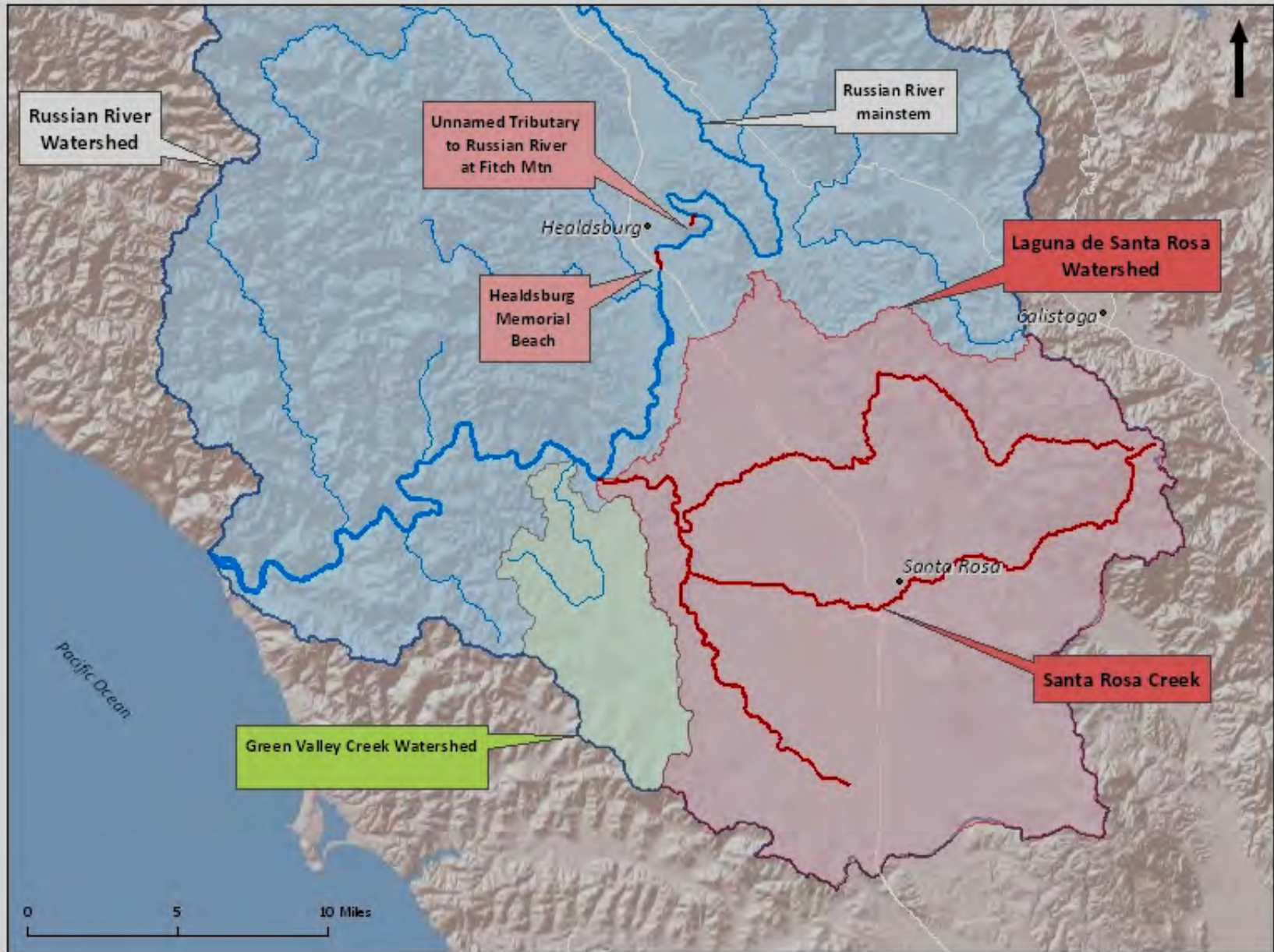
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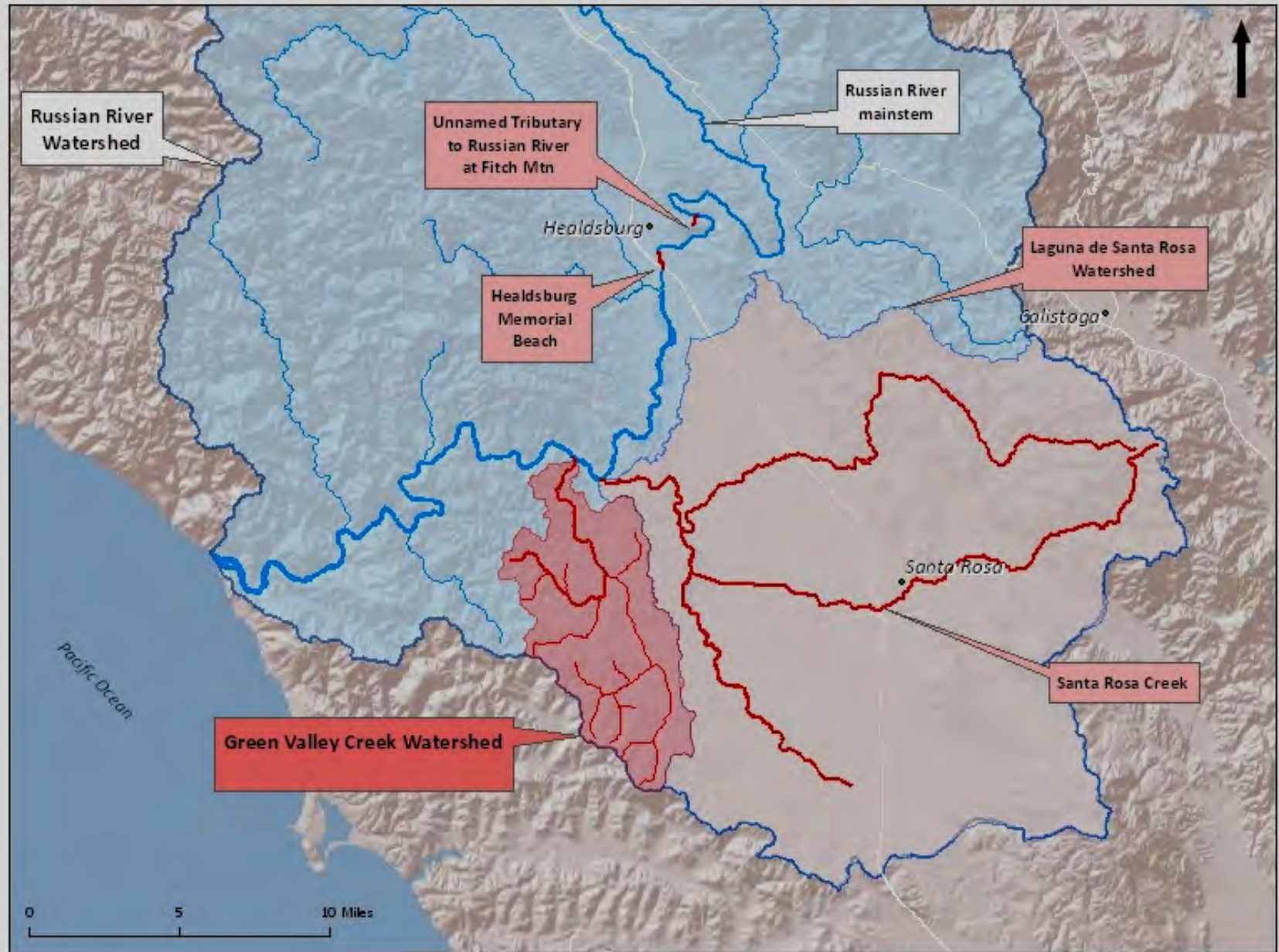
# Russian River Indicator Bacteria Listings



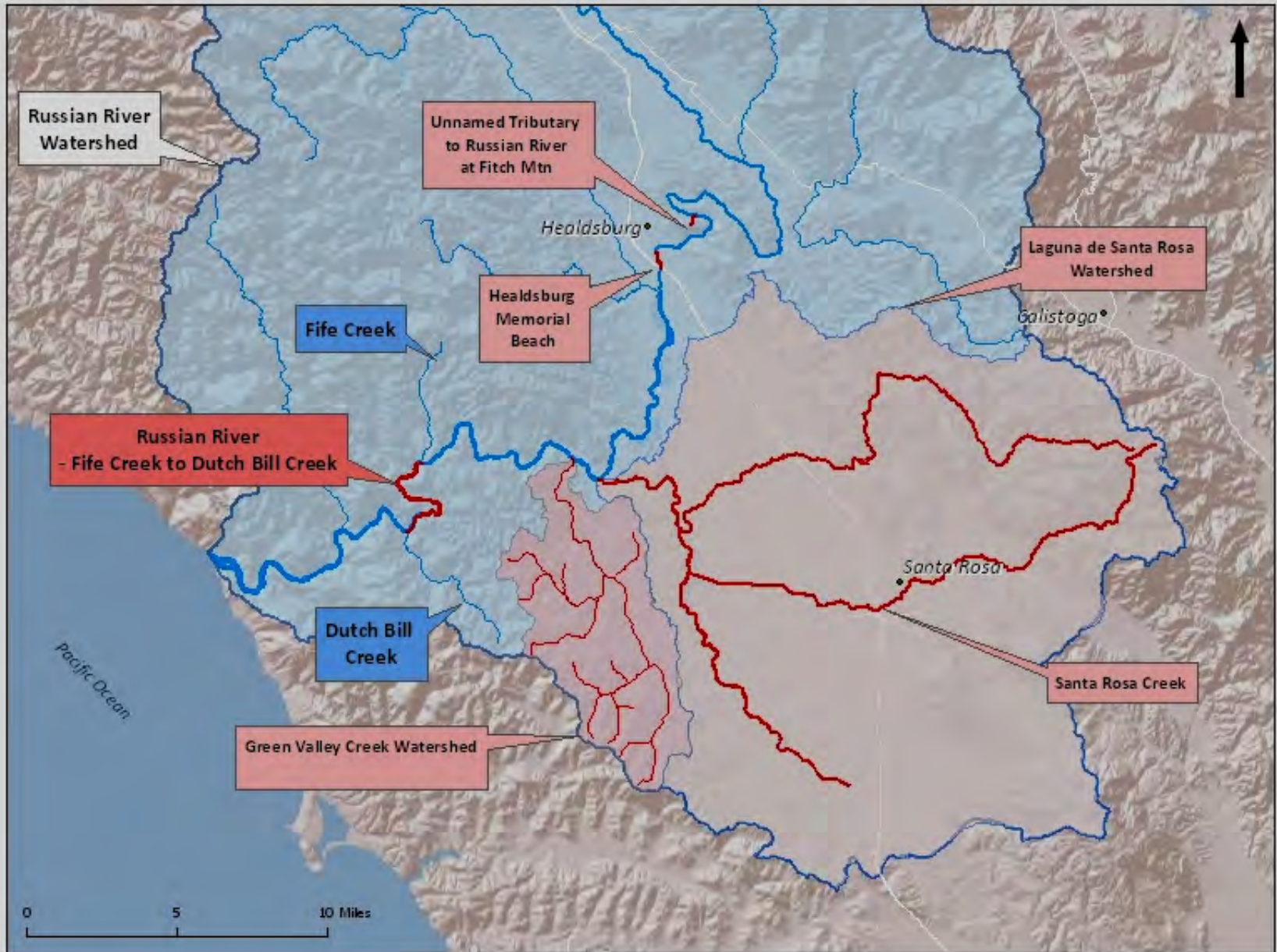
# Russian River Indicator Bacteria Listings



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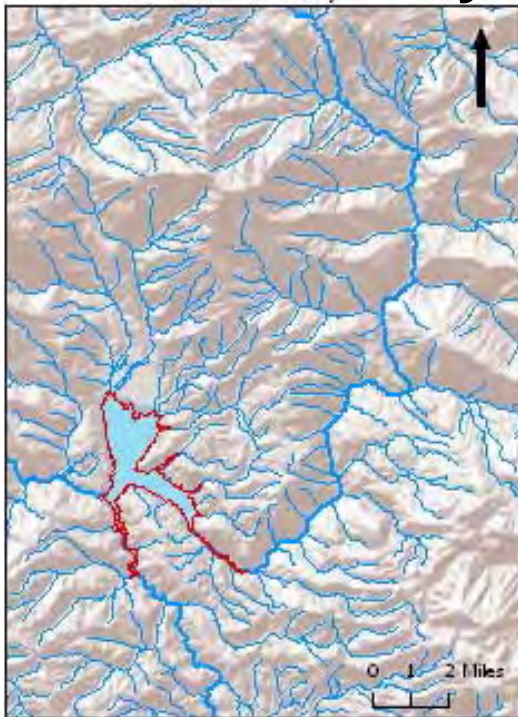
# Three Active TMDL Projects

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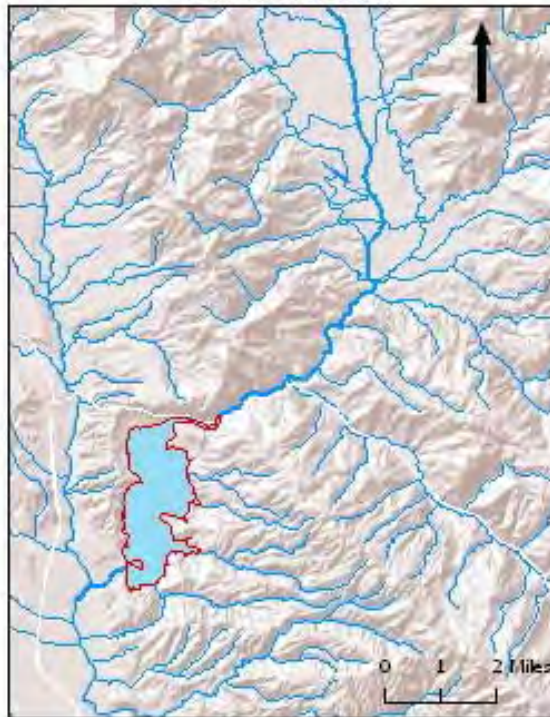
- 1. Reservoir Mercury TMDLs**
- 2. Laguna de Santa Rosa TMDLs**
- 3. Lower Russian Indicator Bacteria TMDLs**

# Reservoir Mercury TMDLs

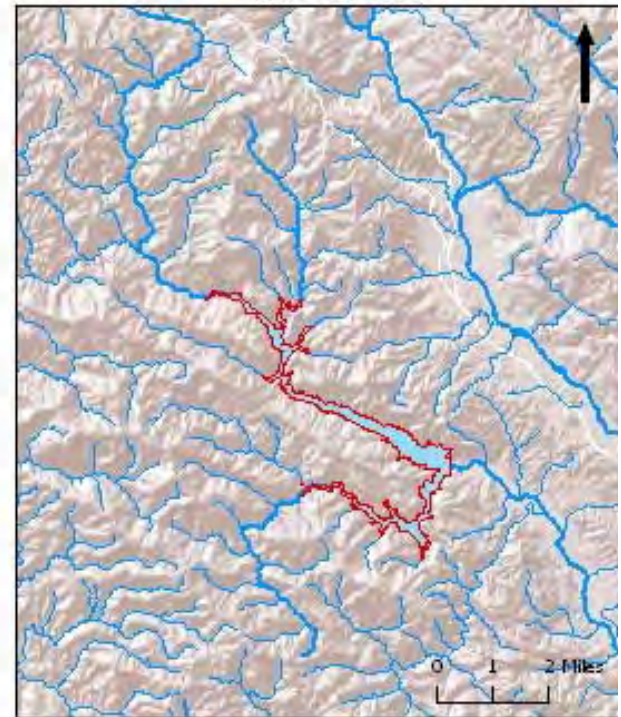
**Lake Pillsbury**



**Lake Mendocino**



**Lake Sonoma**



Lake Pillsbury in Upper Main Eel River HA is included because portions of outflow are diverted to the Russian River.



# **Reservoir Mercury TMDLs**

## **- Background -**

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- **Listings based on USEPA standard for mercury in fillet tissue of game fish of legal size**
- **Consistent exceedence of standard**
  - **Health Advisory in effect in Lake Pillsbury**
  - **Draft Health Advisory for Lakes Mendocino & Sonoma**
  - **May 2010 SWAMP study confirms impairment**



# **Reservoir Mercury TMDLs - Assessment Approach -**

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- **TMDL assessment focus on human health and wildlife protection**
  
- **Approach:**
  - **Evaluate spatial and temporal extent of mercury in reservoirs and their tributaries**
  - **Quantify natural and anthropogenic sources of total and methyl mercury**
  - **Assess linkage of observed conditions to protection of human health and wildlife**



# Reservoir Mercury TMDLs

## Samples Collected 2007-2009

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- **Water in reservoirs, inflows, and outflows**
  - Total-Hg and methyl-Hg
  - TSS
  - Temperature, Dissolved Oxygen, pH
- **Fine sediment in streams**
  - Inflows and upland tributaries
- **Upland watershed soils**
- **Mercury mine and prospect workings**



# **Reservoir Mercury TMDLs - Preliminary Results -**

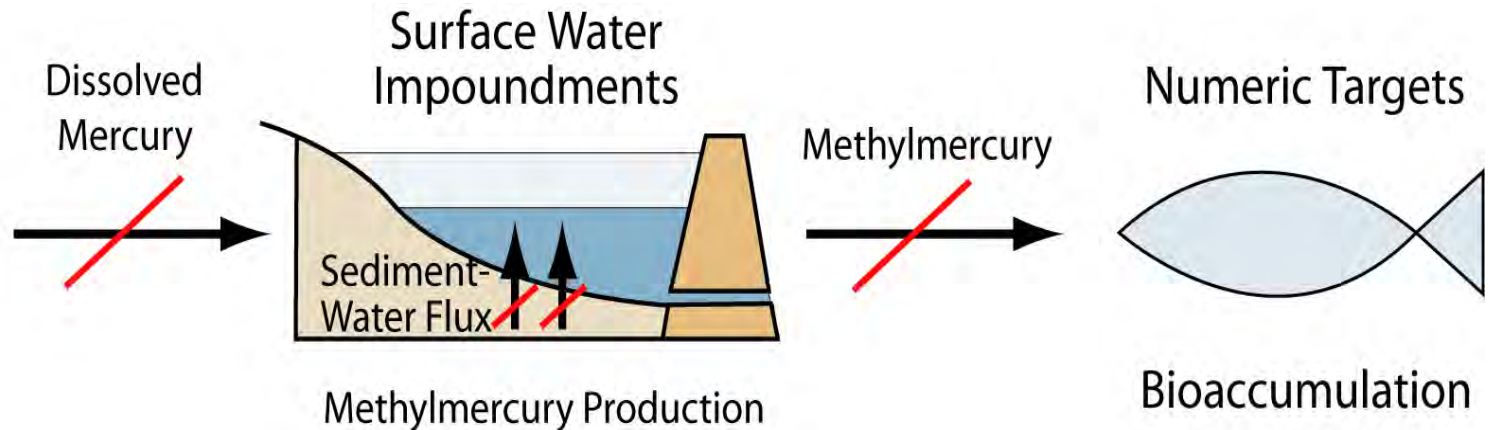
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- **No “smoking gun” anthropogenic sources**
  - **Exceptions = Atmospheric deposition**  
**Warm Springs Mine in Lake Sonoma**
- **Mercury is part of the geology of the watersheds**
- **Reservoir stratification promotes production of toxic form of mercury**

# Solving the Mercury Problem in Reservoirs

## Sources:

- ~~• Mining Wastes~~
- ~~• Urban Runoff~~
- Atmospheric Deposition
- Soil





# **Reservoir Mercury TMDLs**

## **- Next Steps -**

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- **Continue data analyses for source assessment**
- **Need to conduct linkage analysis to inform implementation measures**
- **Work with state-wide team to develop multi-waterbody reservoir/lake mercury TMDLs**



# Laguna de Santa Rosa TMDLs

## for Nitrogen, Phosphorus, Dissolved Oxygen, Temperature and Sediment

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### Topics:

- Scope
- History
- Source Analysis Approach
- Early Implementation
- Stakeholder Involvement
- Schedule

**Includes**

**Waterbodies:**

**Laguna de Santa Rosa**

**Windsor Creek**

**Mark West Creek**

**Santa Rosa Creek**

**Blucher Creek**

**Copeland Creek**

**Cities:**

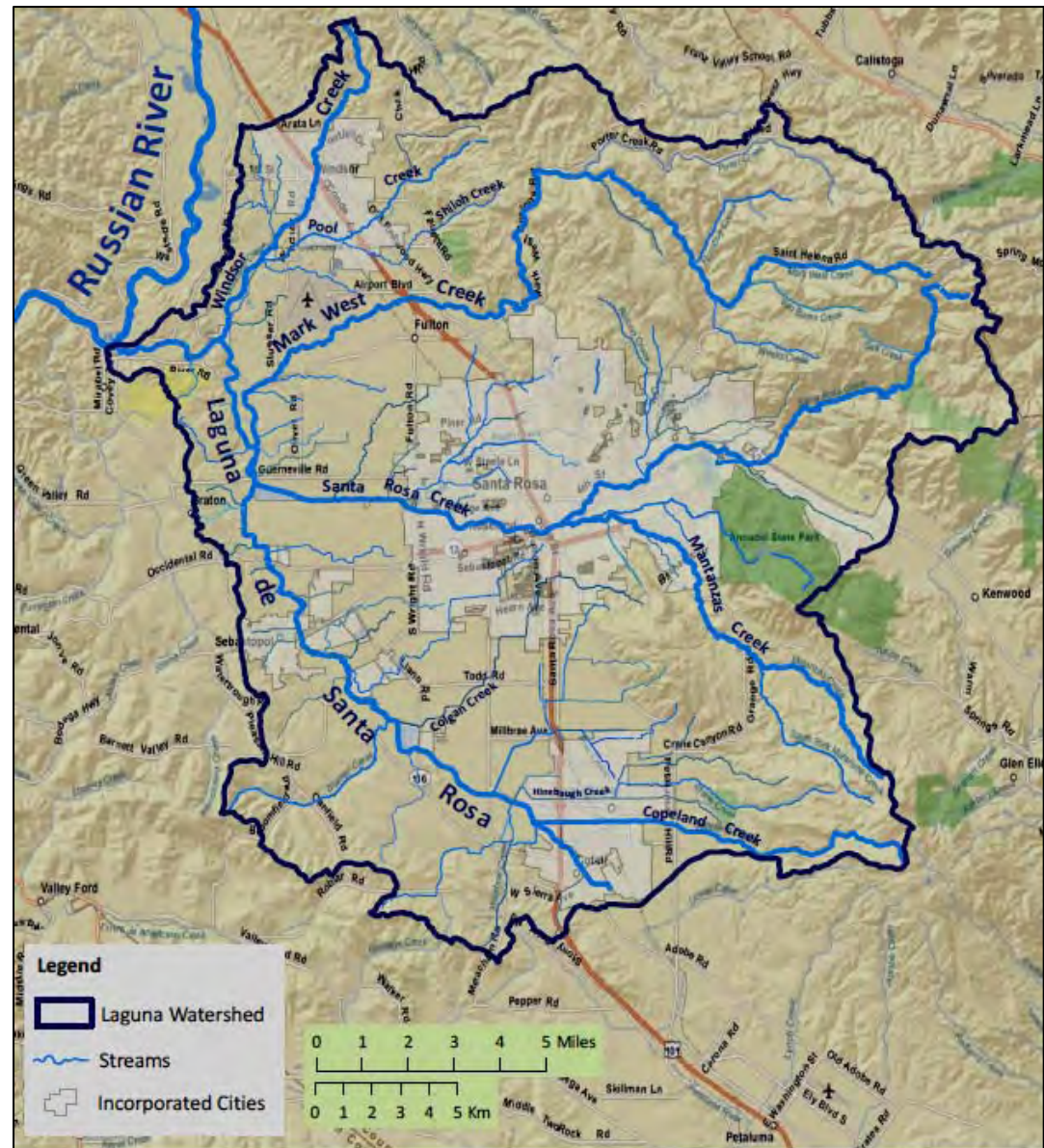
**Windsor**

**Santa Rosa**

**Rohnert Park**

**Cotati**

**Sebastopol**





# Listing History

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- 1976:** Listed for Nutrients, Dissolved Oxygen, and Coliform
- 1990:** Listed for Ammonia and Dissolved Oxygen
- 1995:** Waste Reduction Strategy (TMDL) Completed
- 1998:** Delisted for Nutrients
- 1998:** Listed for Sediment
- 2002:** Listed for Nitrogen, Phosphorus, Dissolved Oxygen, and Temperature
- 2006:** Listed for Mercury (fish tissue)
- 2010:** Listed for Indicator Bacteria



# 303(d) Listed Impairments

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- Nitrogen
  - Phosphorus
  - Low Dissolved Oxygen
  - High Temperature
  - Sediment
  - Mercury
  - Pathogens / Indicator Bacteria
- Current  
TMDL Project



# Waste Reduction Strategy

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- EPA approved in 1995 – Our 1<sup>st</sup> TMDL
- Focused on Nitrogen
- Set Loads and Load Reductions
  - Total Nitrogen
  - Interim Loads by 1996
  - Total Ammonia
  - Final Loads by 2000
- Implementation
  - Reduce sources from dairies through 319(h) Grants and City of Santa Rosa funding
  - Implement urban storm water program
  - Improve wastewater treatment to reduce nitrogen loads
  - Work with stakeholders



# Did the Strategy Work?

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## ■ Yes

- Ammonia toxicity levels dropped
- Improvements at Laguna Wastewater Treatment Plant
- Improvements in dairy waste disposal
- Strategy's interim goals attained
- Delisted for ammonia and dissolved oxygen in 1998

## ■ But

- Dissolved oxygen objectives continued to be violated
- Nutrients caused algae and aquatic plant growth

## ■ Therefore

- Listed for nitrogen, phosphorus, and dissolved oxygen in 2002



# Source Analysis

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- **Temperature**
  - Conduct *Sensitivity Analysis* for representative stream and lake reaches
- **Sediment**
  - Watershed Sediment Budget Study for US Army Corp Engineers (PWA,2004)
- **Nutrients and DO**
  - Empirical Lines-of-Evidence Approach



# Nutrient Source Analysis

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## Step 1: Spatial Distribution of Loading

- 2008 nutrient sampling of major tributaries
- Dry weather samples only

## Step 2: Specific Land Use Loading

- 2009 nutrient sampling of 7 general land uses
- Dry & wet weather samples



# Nutrient Source Analysis

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## Laguna Specific Land Use Loading Estimates

- Seven (7) land uses assessed based on the 2006 National Land Cover Map

## Derived from Several Lines of Evidence:

- Laguna tributary sampling in 2008
- Land use runoff sampling in 2009
- Published scientific literature values
- Estimates derived for the 1995 TMDL & WRS



# Nutrient Source Analysis

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- **Compare to Historical Loading**
  - Current loading estimates will be compared to European Pre-settlement loading estimates as a point of reference
- **Pre-settlement Land Cover Map was prepared based on:**
  - Historical Maps
  - Public Land Surveyor Notes from 1860s
  - Soil Surveys
  - Previous Historical Mapping by David W. Smith Consulting (1990)

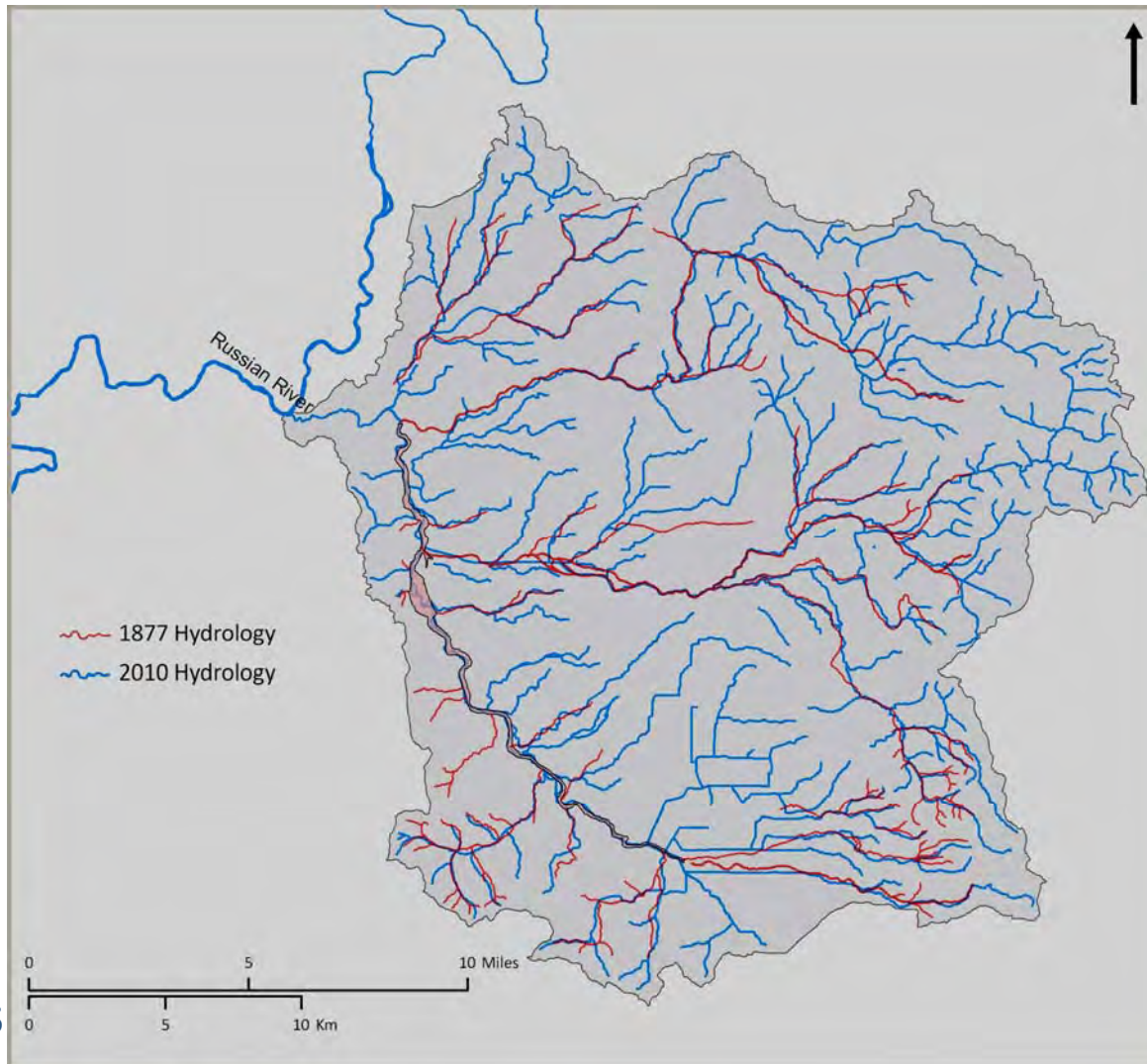
# Historical Maps



**Historical Atlas of  
Sonoma County  
(1877)**

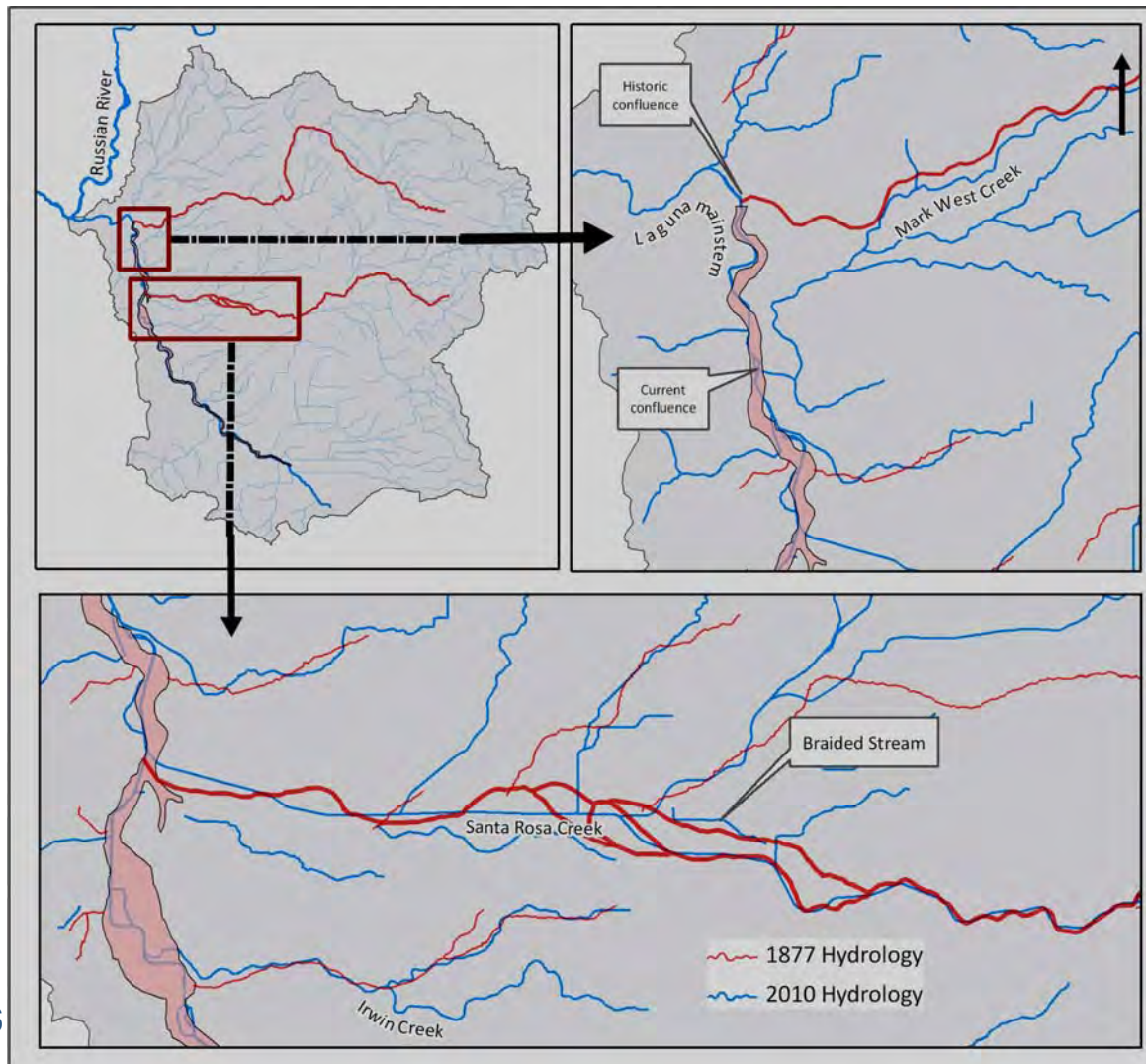
**Overlaid with  
Laguna watershed  
boundary**

# Historic & Current Hydrology



**Red Lines = 1877 Streams**  
**Blue Lines = 2010 Streams**

# Historic & Current Hydrology

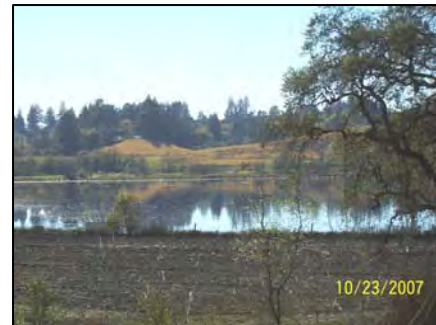


## Laguna Watershed Hydrologic Channel Modifications

**Red Lines = 1877 Streams**

**Blue Lines = 2010 Streams**

# Physical Processes & Changes





# Next Analysis Steps

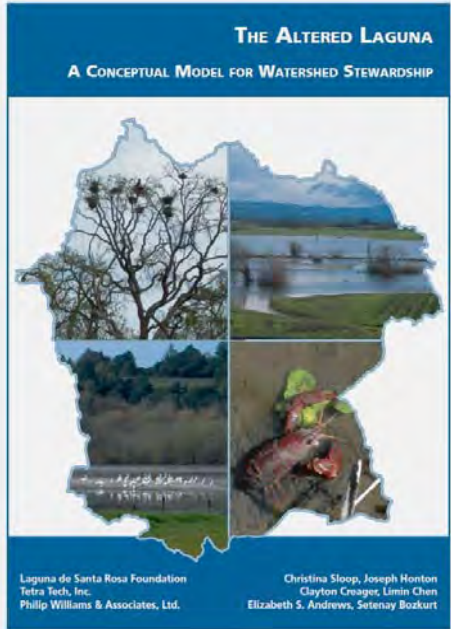
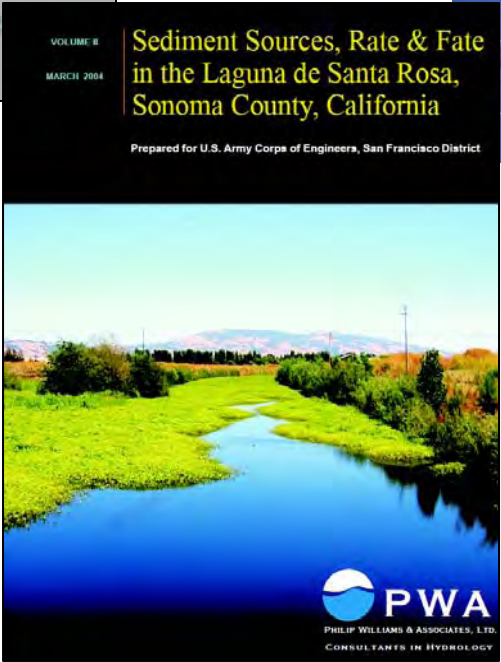
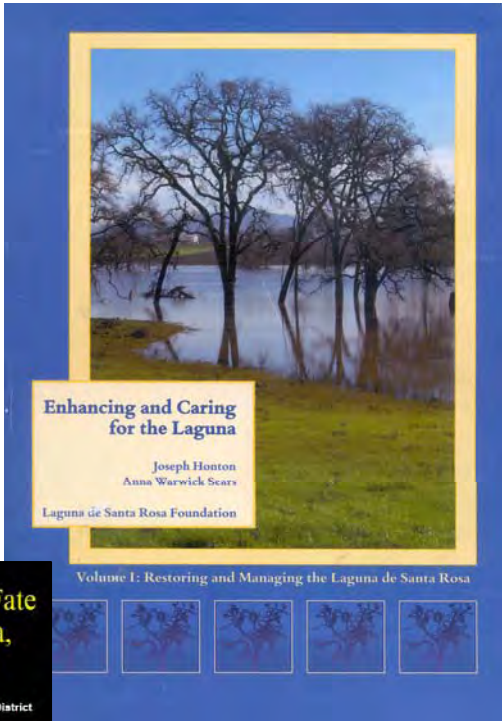
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## ■ Linkage Analysis

- Model representative Lake and Stream reaches (both empirical and mechanistic models)
- Assess model sensitivity to changes in critical conditions and seasonal variation

## ■ Numeric Targets

- Estimate stream and lake water quality conditions using Pre-settlement land cover nutrient loading



# Report Recommendations/Highlights



- Nutrient Load Reduction
- Sediment Reduction
- Historic Hydrology Restoration
  - Stream Channel Reconfiguration
- Wetland Preservation & Restoration
  - Open Water Lakes
  - Wetlands
  - Vernal Pools
- Riparian Preservation & Restoration
- Invasive Plant (Ludwigia) Removal



# Early Implementation

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- **City of Santa Rosa Wastewater Nutrient Offset Program**
- **Urban Storm Water Program**
- **Dairy Permitting**
- **Restoration Activities**
  - **Laguna Foundation**
  - **City of Santa Rosa**
  - **Resource Conservation Districts**
  - **Others**

# Stakeholder Involvement

- **Critical for success**

- **Stakeholder Plan**

- [http://www.waterboards.ca.gov/northcoast/water\\_issues/programs/tmdls/laguna\\_de\\_santa\\_rosa](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/laguna_de_santa_rosa)

- **Goals**

- **Communicate with and inform stakeholders**
- **Solicit and receiving useful input**
- **Community support**





# Stakeholder Involvement

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- **Stakeholder Meetings**
- **Webpage**
- **Fact Sheets / Newsletters**
- **E-mail & Mail**
- **Status Updates to the Board**
- **Public Review of TMDL documents**



# Laguna TMDLs Schedule

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<b>Ongoing</b>	<b>Stakeholder Involvement</b>
<b>Dec 2010</b>	<b>Technical Analysis (Draft)</b>
<b>2011</b>	<b>Implementation Plan Development</b>
<b>Summer 2011</b>	<b>Peer Review</b>
<b>Nov 2011</b>	<b>Santa Rosa Wastewater Permit Renewal</b>
<b>Summer 2012</b>	<b>Public Review of Draft TMDLs</b>
<b>Fall 2012</b>	<b>Regional Board Hearing</b>
<b>Fall 2013</b>	<b>State Board Hearing</b>
<b>2014</b>	<b>EPA Approval</b>



# **Russian River Indicator Bacteria TMDLs**

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## **Topics:**

- **Beneficial Use Impairments**
- **UC Davis Pilot Study**
- **TMDL Monitoring Plan**
- **Early Implementation**
- **Schedule**

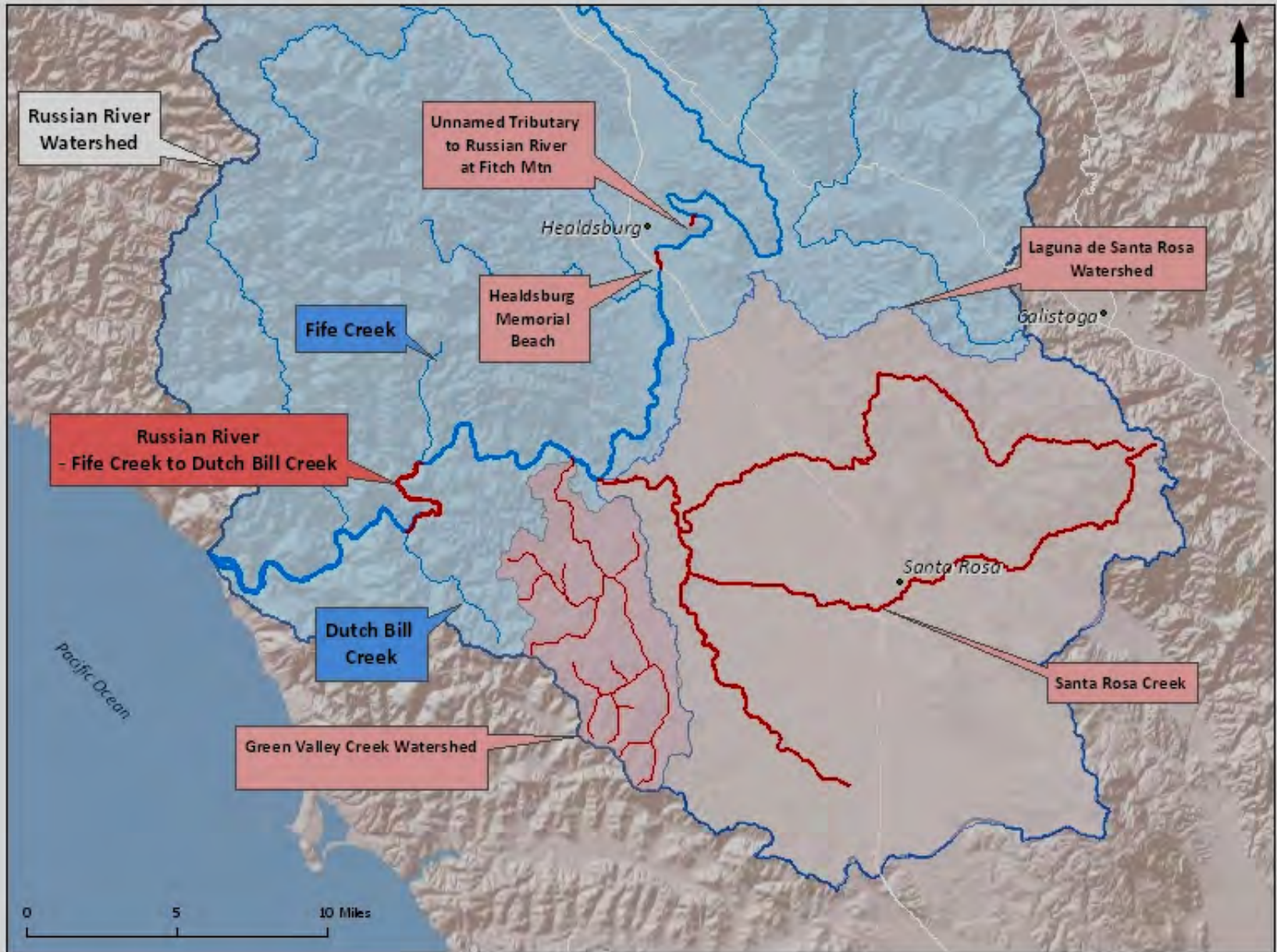


# Beneficial Use Impairment

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- **Impaired Uses: REC-1, SHELL**
- **2008/2010 Section 303(d) Indicator Bacteria Impaired Waters:**
  - Russian River from Guerneville to Monte Rio
  - Russian River at Healdsburg Memorial Beach
  - Unnamed Stream near Healdsburg
  - Santa Rosa Creek watershed
  - Laguna de Santa Rosa watershed
  - Green Valley Creek watershed

# Russian River Indicator Bacteria Listings

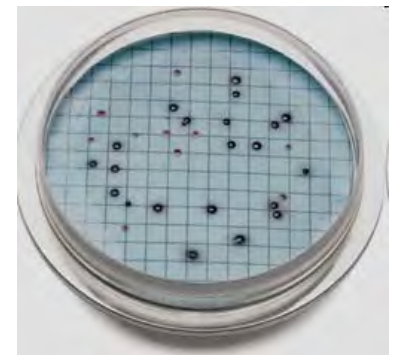


# Pathogenic Indicator Bacteria

- Waterborne Human Pathogenic Microorganisms:
  - Bacteria – *V. cholerae*, *salmonella*, *shigella*
  - Protozoa – *giardia*, *cryptosporidium*
  - Viruses – *hepatitis A*, *rotavirus*
  - Helminths (*parasitic worms*)
- Limitations to Direct Measurement of Pathogens
- Use of Indicator Organisms as '*Indicators*' of contamination by pathogenic microorganisms
- Section 303(d) listings based on these **Indicator Bacteria** concentrations:
  - *Total coliform bacteria*
  - *Fecal coliform bacteria*
  - *E. coli*
  - *Enterococcus*



*E. coli*



Total & Fecal Coliform



# TMDL Pilot Study

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- UC Davis Researchers investigated various **Microbial Source Tracking (MST)** approaches for application in the Russian River watershed
  
- Developed Monitoring Recommendations for TMDL development:
  1. Increase number of locations monitored
  2. Increase monitoring frequency during wet periods
  3. Evaluate sampling variability
  4. Assess land use influence
  5. Analyze for *Bacteroides* and stable N & O isotopes



# TMDL Pilot Study

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## Recommended MST Analyses:

### ■ Bacteroides Bacteria

- Bacteroides bacteria live in intestines of warm-blooded animals
- Bacteroides are short-lived in ambient water conditions without re-growth
- Bacteroides genetic markers are specific to the host animal
- Quantitative polymerase chain reaction (qPCR) with host-specific genetic markers **can distinguish between human, cows, canines and bird sources**

### ■ Stable Isotope Analysis (SIA)

- Measures the difference between the sources of oxygen and nitrogen used for bacterial nitrification
- SIA can distinguish between runoff from sewered areas and areas with septic systems and manure



# TMDL Monitoring Plan

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## Management Questions:

1. Are Basin Plan Water Quality Objectives being met?
2. What is the variability of indicator bacteria?
  - Sampling variability
  - Analytical laboratory variability
  - Spatial variability
  - Temporal variability
3. What are the most significant sources?
4. What are the natural background levels of indicator bacteria?
5. Do beach areas pose a higher risk to REC-1 than non-beach reaches?



# TMDL Monitoring Plan

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## ■ Fecal Indicator Bacteria

- In-house laboratory certification underway for Colilert® and Enterolert® analyses
- Allows sampling for storm events and weekends
- Analysis cost is 30% of contract lab cost
- Sonoma County Health Services analyzing QA samples

## ■ Bacteroides

- Sonoma County Health Services analyzing *Bacteroides* samples
- UC Davis Aquatic Ecosystem Analysis Lab under contract for QA and instrument optimization

## ■ Stable Isotope Analysis

- UC Davis Stable Isotope Facility under State Lab Contract



# New MST Technology

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## Phylochip®

- Developed by Berkeley National Lab with Homeland Security funding
- Rapid, repeatable, and standardized method
- New commercial lab ready to receive samples
- Results provide a full census of the entire microbial community
- Quantifies over 50,000 different bacteria in a single sample ***including*** all Human pathogens (but not viruses)
- Measured micro-biome communities can be used to identify specific sources of pathogens
- Recent Phylochip applications in ambient water include:
  - Tracking the 2009 sewage spill in Richardson Bay
  - Projects conducted under the Proposition 50 Clean Beaches Initiative
  - 15 international studies



# Staff ideas for TMDL Early Implementation Options

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- Regulatory Actions
  - Correction of non-compliant septic systems
  - Requirements for dairies
  - Enforcement of requirements for sanitary sewers systems
  - Implementation of Supplemental Environmental Projects (SEPs)
- Public Outreach
  - Signage for public education at recreation areas
  - Portable toilets in “unofficial” recreation areas
  - Coordinate with relevant government agencies and NGOs on homeless encampments
  - Outreach and education on horse waste management
- Outreach to Regulated Community
  - Russian River Watershed Association



# Indicator Bacteria TMDL Schedule

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Summer 2010 – Fall 2011	Conduct Monitoring
October 2011 – June 2012	Develop TMDLs
2013	Regional Board Hearing

# Contact Information

## Webpage:

[http://www.waterboards.ca.gov/northcoast/water\\_issues/programs/tmdls/](http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/)

## Mailing List:

[http://www.waterboards.ca.gov/resources/email\\_subscriptions/reg1\\_subscribe.shtml](http://www.waterboards.ca.gov/resources/email_subscriptions/reg1_subscribe.shtml)

## Phone:

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